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Post-Cephalic White Spot Syndrome in Salmonids



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This report documents a phenomenon in salmonids involving one or more white spots generally located in the mid-dorsal nape or occipital region immediately posterior of the fishes' head. This syndrome, post-cephalic white spot (PCWS), varies widely among populations. When present, it is often found in less than 0.1% of individuals in a population although in some instances occurrence rates can be considerably higher. This anomaly is easily overlooked and often goes unnoticed, especially when viewing a large number of fish. The white pigment spots, only a few millimeters in diameter in juveniles, grow allometrically and are larger in older fish. Although PCWS is found in all life stages including adult salmonids, it has been more commonly noted in juveniles, suggesting that when present, the syndrome carries a distinct survival liability.

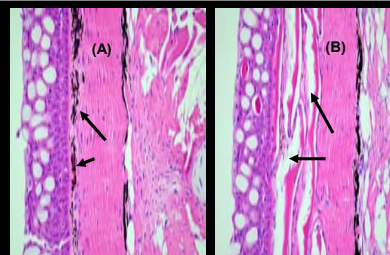
The author first observed PCWS on salmonids in 1975, and since then the anomaly has been documented in all five species of North American salmon, rainbow trout, Dolly Varden, and Atlantic salmon. Data is reviewed on the presence and, where available, occurrence rates of PCWS in 37 populations from Alaska, Washington, Oregon, British Columbia, New Hampshire, Australia, and Hokkaido, Japan. While PCWS has been observed on both wild and hatchery origin salmonids it more commonly has been seen in hatchery fish, perhaps because large numbers of hatchery-origin fish, especially juveniles, can be more readily observed than wild fish. Initial histological comparisons of juvenile chinook and sockeye salmon with and without PCWS show subcutaneous differences including a lack of melanocytes in epidermal tissues and the likely presence of purine crystals that may cause the white pigmentation in dermal tissues. Pathological examination of sibling sockeye salmon with and without white spots revealed no significant differences although one specimen without PCWS did have a protozoal gill infection. Preliminary DNA comparisons of sibling chinook salmon with and without white spots suggest a genetic linkage; in one instance 7 of 27 juveniles with white spots from a population of 218,000 fish came from the same parents.



Nakvassin Creek Sockeye Salmon



Nakvassin Creek Sockeye Salmon



Cross sections of juvenile chinook salmon: (A) pre-PCWS area showing prominent chromatophores beneath epidermal cell layer (1); and (B) PCWS region showing lack of chromatophores between dermal and epidermal tissues and vacuolated areas in dermal tissue that may contain purine crystals causing white pigments (2).



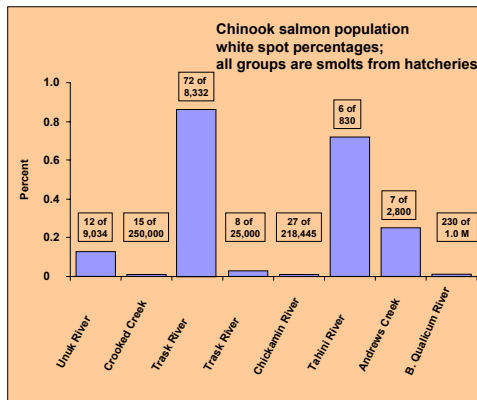
PCWS slash on coho salmon



Coho salmon smolts with left and right side slashes



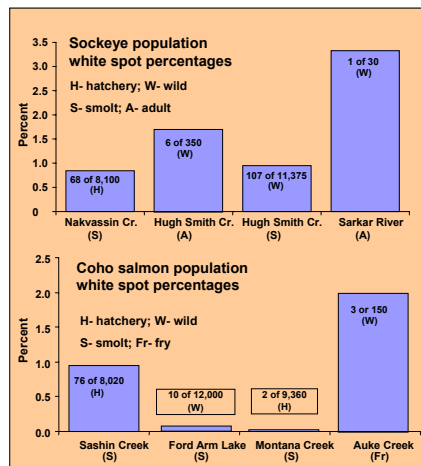
This photo of 2001- brood Tahani River chinook salmon smolts from DIPAC Hatchery near Juneau has at least one PCWS fish in the group. Can you find it?



A different but perhaps related white pigmented anomaly has been observed in juvenile chum and coho salmon where a white slash from the post-cephalic dorsal region traverses ventrally toward the pectoral fin (shown at right). White slashes occur on both right or left sides and are associated with pectoral girdle or fin deformation. The condition has been observed only in hatchery-origin fish.

Causes of either PCWS or white slashes are unknown although some possibilities include teratogenic malformed anomalies due to exogenous environmental factors such as heavy metals, pesticides, or other chemicals, chromosomal aberrations in one or the other parent, inappropriate mate selection, or interaction of genetic and environmental factors during embryogenesis.

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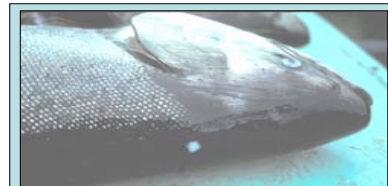
Hugh Smith Lake sockeye salmon smolts with PCWS May 19, 1988



Adult pink salmon with Post-Cephalic White Spots



Nakvassin Creek sockeye salmon



Adult chinook salmon caught at Yakobi Is., Alaska



Adult chum salmon caught at Juneau, Alaska